

**CAYMAN ISLANDS
DEPARTMENT OF
ENVIRONMENTAL HEALTH (DEH)**



**Indoor Mould Prevention and
Remediation in Buildings**

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PREFACE

Public concern about indoor exposure to mould has increased in recent years in particular in North America and Europe, as mould can potentially cause a wide range of health problems. These concerns came into focus in the Cayman Islands following the water intrusion damage caused by Hurricane Ivan in September 2004. In 2009 the World Health Organization (WHO) issued the **WHO Guidelines on Indoor Air Quality: Dampness and Mould** where it was recognized that dampness is a strong and consistent indicator of risk of asthma and respiratory symptoms. Excess moisture on almost all indoor materials leads to the growth of microbes such as mould, fungi and bacteria which subsequently emit spores, cells, fragments or volatile organic compounds into the indoor air. However, there is a certain amount of uncertainty surrounding the causal exposure and health effects. For this reason WHO recommends that persistent dampness and microbial growth on interior surfaces and in building structures should be avoided or minimized, as they may lead to adverse health effects. Indicators of dampness and microbial growth include the presence of condensation on surfaces or in structures, visible mould, and perceived mouldy odour (WHO, 2009).

Many fungi (e.g., species of *Aspergillus*, *Penicillium*, *Fusarium*, *Trichoderma*, and *Memnoniella*) are able to produce potent mycotoxins. Mycotoxins are organic compounds that are secondary fungal metabolites and have been identified as potentially toxic to a wide range of other living organisms including humans. Exposure to mycotoxins can occur in the form of inhalation, ingestion or skin contact.

Fungi can also cause allergic reactions in sensitive persons. The most common symptoms are runny nose, eye irritation, cough, congestion, aggravation of asthma, headaches, sneezing and skin rash (dermatitis).

People performing renovations/cleaning of widespread fungal contamination may be at risk for developing Organic Dust Toxic Syndrome (ODTS) or Hypersensitivity Pneumonitis (HP). ODTS may occur after a single heavy exposure to dust contaminated with fungi and produces flu-like symptoms; it differs from HP in that it is not an immune-mediated disease and does not require repeated exposures to the same causative agent. A variety of biological agents may cause ODTS including common species of fungi. HP may occur after repeated exposures to an allergen and can result in permanent lung damage.

Taking into consideration the above mentioned health issues related to both acute and chronic exposure to mould; this document presents guidelines and recommended actions for the remediation / cleanup of mould in buildings. It was prepared based primarily on the following documents: **Mould Remediation in Schools and Commercial Buildings (EPA 2008)**, **NY Guidelines on Assessment and Remediation of Fungi in Indoor Environments (2008)**, **WHO Guidelines for Indoor Air Quality: Dampness and Mould (WHO 2009)** and the **NIOSH Alert: Preventing Occupational Respiratory Disease from Exposures Caused by Dampness in Office Buildings, Schools and Other Non-Industrial Buildings (NIOSH 2012)**.

These guidelines are to be used mainly by those involved in mould prevention and remediation such as: environmental health officers; tourism accommodation inspectors; property managers; facility managers responsible for the maintenance of large buildings (hotels, condos, schools, hospitals, etc.); building contractors and the general public. Thus individuals using these guidelines with little to no experience in mould remediation should be able to make a reasonable judgment as to whether the required remediation for moulds can be handled in-house or should be submitted to companies / consultants with experience in mould remediation.

INTRODUCTION

The term “mould” is a colloquial term for a group of filamentous fungi that are common on food or wet materials. Moulds are part of the natural environment and can be found almost anywhere as they can grow on all types of materials with an organic substrate such as: wood, paper, carpets, foods and insulation materials. Mould spores can be found indoors as well as outdoors and cannot be eliminated entirely from indoor environment. They also require moisture and oxygen for growth.

Outdoors, moulds play an important role in nature by breaking down dead organic matter such as fallen leaves and dead trees. However, indoors, mould growth should be avoided.

Moulds reproduce by means of microscopic spores; the spores are invisible to the naked eye and float through outdoor and indoor air. When spores land on damp spots indoors and find a substrate for growth, they develop into moulds and digest the surrounding materials forming larger and larger colonies. During this process various species of mould compete for the same substrate (food) and release organic substances that are toxic to other mould species which can also be toxic and /or irritants to humans.

There are many types of mould, and the colonies have many colours (white, black, green, etc). Most species of mould grow in moist and dark areas. Indoors, since it needs moisture to grow, mould becomes a problem when there is water damage, elevated or prolonged high humidity or dampness.

Under normal circumstances mould growth occurs around damp areas in bathrooms and kitchens; these areas can be hard to maintain completely free of mould. If there’s some mould for example in the shower or elsewhere in the bathroom that seems to reappear, increasing the ventilation (running a fan or opening a window) and cleaning more frequently, will usually prevent mould from recurring, or at least keep the mould to a minimum.

After a catastrophic event such as a hurricane, where widespread damage to buildings occurs and, rain water, seawater and sewage infiltrate buildings, mould can / will appear in the areas that have been exposed or damaged.

COMMON QUESTIONS

Why does mould grow in homes and other buildings?

As mould requires humidity and organic matter for growth, mould can begin growing indoors when mould spores land on surfaces that are damp and contain cellulose that can be used as foodstuff for the moulds such as: the paper in sheetrock, wood, pressed wood or glue-containing surfaces behind wallpaper.

Can mould cause health problems?

Moulds are usually not an indoor problem, unless mould spores land on a wet or damp spot and begin growing and reproducing. In this case moulds have the potential to cause health problems.

The inhalation of fungal spores, fragments (parts), or metabolites (e.g., mycotoxins and volatile organic compounds) from a wide variety of fungi may lead to or exacerbate immunologic (allergic) reactions, cause toxic effects, or cause infections.

Inhaling or touching mould or mould spores may cause allergic reactions in sensitive individuals. Allergic responses include hay fever-type symptoms, such as sneezing, runny nose, red eyes, and skin rash (dermatitis). Allergic reactions to mould are quite common and can be immediate or delayed. Mould can also cause asthma attacks in people who already have asthma and who are allergic to mould. In addition, mould exposure can irritate the eyes, skin, nose, throat, and lungs.

For more detailed information consult a health professional.

How to avoid indoor mould growth?

It is extremely difficult if not impossible to prevent and /or eliminate all indoor mould and mould spores as some mould spores will be found floating through the air and in dust. However, the mould spores will not grow if moisture is not present. Indoor mould growth therefore can and should be prevented or controlled by controlling moisture indoors. If there is mould growth in certain areas of a building, then mould remediation and the fixing of existing water infiltration problems from plumbing fixtures and roof leaks must be addressed at the same time. If the source of humidity is not fixed then, most likely, the mould problem will reoccur.

Who should do mould remediation / cleanup?

This is a judgment call that depends on, a number of factors. The most important consideration is the size of the mould problem. If the mouldy area is less than about 10 square feet (less than roughly a 3 ft. by 3 ft. patch), in most cases, the job can be handled in-house.

If there has been a lot of water damage, such as extensive damage to the roof of a building and / or flooding during a hurricane, and / or mould growth covers more than 10 square feet of your building, consult / use the services of a qualified professional and follow these guidelines or other similar overseas guidelines from professional or government organizations.

If you suspect that the heating/ventilation/air conditioning (HVAC) system may be contaminated with mould (it is part of an identified moisture problem, for instance, or there is mould near the intake to the system), consult a HVAC professional before taking further action. Do not run the HVAC system if you know or suspect that it is contaminated with mould - it could spread mould throughout the building.

If the water and/or mould damage was caused by sewage infiltration or other contaminated water, use the services of a professional remediation / cleaning company with experience in cleaning and fixing buildings damaged by contaminated water.

If you choose to use outside contractors or professionals, make sure they have experience cleaning up mould, check their references and have them follow the recommendations presented in this document, and / or guidelines from other professional organizations. Contact the Department of Environmental Health (DEH) or the Cayman Islands Facilities Managers Association (CIFMA) or the Cayman Contractors Association (CCA) for access to the register of local service providers who

have demonstrated that they possess the minimum qualifications for this work by taking part in training that provides the core competencies.

If you or your tenants have or have expressed health concerns, consult a health professional before starting cleanup.

PREVENTION OF MOULD GROWTH

The key to control indoor mould growth is the control of moisture.

Table 1: Guidelines for the prevention of mould growth in indoor surfaces

1. Fix leaky plumbing and leaks in the building envelope as soon as possible.
2. Watch for condensation and wet spots. Fix source(s) of moisture problem(s) as soon as possible.
3. Prevent moisture due to condensation by increasing surface temperature or reducing the moisture level in the air (humidity). To increase surface temperature, insulate or increase air circulation. To reduce the moisture level in the air, repair leaks, increase ventilation (if outside air is cold and dry), or dehumidify (if indoor air is warm and humid).
4. Keep heating, ventilation, and air conditioning (HVAC) drip pans clean, flowing properly, and unobstructed.
5. Vent moisture-generating appliances, such as dryers, to the outside where possible.
6. Maintain low indoor humidity, below 65% Relative Humidity (RH) in warm climates, ideally 30-50% RH, if possible.
7. Perform regular building/HVAC inspections and maintenance as scheduled.
8. Clean and dry wet or damp spots within 48 hours of event, if possible.
9. Avoid having wet building foundations. Whenever possible, provide drainage and slope the ground away from the foundation.
10. Clean and repair roof gutters regularly

Source: Mould Remediation in Schools and Commercial Buildings, EPA, Reprinted September 2008, Website Update March 2017, (modified).

WATER DAMAGE – CLEANUP AND MOULD PREVENTION

Significant mould growth can occur in as little as 48 hours after water damage. If the damage is caused by **clean** water, the best approach is to minimize or prevent mould growth by the actions in Table 2:

Table 2: Water Damage – Cleanup and Mould Prevention

Guidelines for Response to Clean Water Damage within 24 – 48 Hours to Prevent Mould Growth	
Water-Damaged Material	Actions
Books and papers	<ul style="list-style-type: none"> * For non-valuable items, discard books and papers. * Photocopy valuable/important items, discard originals. * Freeze (in frost-free freezer or meat locker) or freeze-dry.
Carpet and backing – dry within 24 – 48 hours	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Reduce ambient humidity levels with dehumidifier. * Accelerate drying process with fans. * The subfloor under the carpet or other flooring material must also be cleaned and dried.
Ceiling tiles	<ul style="list-style-type: none"> * Discard and replace.
Cellulose insulation	<ul style="list-style-type: none"> * Discard and replace.
Concrete or cinder block surfaces	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters.
Fiberglass insulation	<ul style="list-style-type: none"> * Discard and replace.
Hard surface, porous flooring§ (Linoleum, ceramic tile, vinyl)	<ul style="list-style-type: none"> * Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary. * Check to make sure underflooring is dry; dry it if necessary.
Non-porous, hard surfaces (Plastics, metals)	<ul style="list-style-type: none"> * Vacuum or damp wipe with water and mild detergent and allow to dry; scrub if necessary.
Upholstered furniture	<ul style="list-style-type: none"> * Remove water with water extraction vacuum. * Accelerate drying process with dehumidifiers, fans, and/or heaters. * May be difficult to completely dry within 48 hours. If the piece is valuable, you may wish to consult a restoration/water damage professional who specializes in furniture.
Wallboard (Drywall and gypsum board)	<ul style="list-style-type: none"> * May be dried in place if there is no obvious swelling and the seams are intact. If not, remove, discard, and replace. * Ventilate the wall cavity, if possible.
Window drapes	<ul style="list-style-type: none"> * Follow laundering or cleaning instructions recommended by the manufacturer.
Wood surfaces	<ul style="list-style-type: none"> * Remove moisture immediately and use dehumidifiers, gentle heat, and fans for drying. (Use caution when applying heat to hardwood floors.) * Treated or finished wood surfaces may be cleaned with mild detergent and clean water and allowed to dry. * Wet paneling should be pried away from wall for drying.
<p>Notes:</p> <p>If mould growth has occurred or materials have been wet for more than 48 hours, remediation must be done. Even if materials are dried within 48 hours, mould growth may have occurred. Items may be tested by professionals if there is doubt. Note that mould growth will not always occur after 48 hours; this is only a guideline.</p> <p>These guidelines are for damage caused by clean water. If you know or suspect that the water source is contaminated with sewage, or chemical or biological pollutants, then Personal Protective Equipment and containment are required. An experienced professional should be consulted if you and/or your remediators do not have expertise remediating in contaminated water situations. Do not use fans before determining that the water is clean or sanitary.</p>	

Source: *Mould Remediation in Schools and Commercial Buildings*, EPA, Reprinted September 2008, Website Update March 2017, (modified).

In addition to health problems the presence of mould may cause staining and cosmetic damage to a wide range of materials. It may not be possible to clean an item so that its original appearance is restored. Absorbent or porous materials, such as ceiling tiles and carpet, may have to be thrown away if they become mouldy. Mould can grow on or fill in the empty spaces and crevices of porous materials, so the mould may be difficult or impossible to remove completely.

CLEANING MOULDY AREAS

1. Avoid exposing yourself or others to mould
 - a. Avoid breathing in mould or mould spores. In order to limit your exposure to airborne mould spores, you may want to wear an N-95 or P100 respirator, available at many hardware stores. In order to be effective, the respirator or mask must fit properly, so carefully follow the instructions supplied with the respirator. Consult the C.I. Department of Environmental Health Laboratory for information on how to fit it properly.
 - b. Wear gloves. Long gloves that extend to the middle of the forearm are recommended. When working with water and a mild detergent, ordinary household rubber gloves may be used. If you are using a disinfectant, a biocide such as chlorine bleach, or a strong cleaning solution, you should select gloves made from natural rubber, neoprene, nitrile, polyurethane, or PVC. Avoid touching mould or mouldy items with your bare hands.
 - c. Wear goggles. Goggles that do not have ventilation holes are recommended.
2. Do not paint or caulk mouldy surfaces. Clean up the mould and dry the surfaces before painting. Paint applied over mouldy surfaces is likely to peel.
3. If you are unsure about how to clean an item, or if the item is expensive or of sentimental value, you may wish to consult a specialist.
4. Look for / use specialists who are affiliated with professional organizations.

MINIMISING HIGH HUMIDITY INDOORS

Maintain low indoor humidity, below 65% Relative Humidity (RH), ideally 30-50% RH, if possible. To achieve this:

1. Ensure that the ground slopes away from the building foundation, so that water does not enter or collect around the foundation.
2. Keep air-conditioning drip pans clean and the drain lines unobstructed and flowing properly
3. Condensation on the inside of window panes can be a sign of high humidity. If you see condensation or moisture collecting on windows, walls or pipes - ACT QUICKLY to dry the wet surface and reduce the moisture / water source.
4. Vent all appliances that produce moisture to the outside. These include: dryers, stoves, AC units, etc. In particular, combustion appliances such as stoves produce water vapour and will increase humidity unless vented to the outside.
5. Use air conditioners and/or de-humidifiers when needed.
6. Run the bathroom fan or open the window when showering. Use exhaust fans or open windows whenever cooking, running the dishwasher or dishwashing, etc.

7. Increase ventilation or air movement by opening doors and/or windows, when practical. Use fans as needed.
8. Cover cold surfaces, such as cold water pipes, with insulation. Rust is an indicator that condensation is present on drainpipes. The pipes should be insulated to prevent condensation.
9. Increase the air temperature.

SUSPICION OF HIDDEN MOULD:

You may suspect hidden mould if a building smells mouldy, but you cannot see the source, or if you know there has been water damage and residents are reporting health problems. Mould may be hidden in places such as: the back side of dry wall, wallpaper, or paneling, the top side of ceiling tiles, the underside of carpets and pads, etc. Other possible locations of hidden mould include areas inside walls around pipes (with leaking or condensing pipes), the surface of walls behind furniture (where condensation forms), inside ductwork, and in roof materials above ceiling tiles (due to roof leaks or insufficient insulation).

Investigating hidden mould problems may be difficult and will require caution when the investigation involves disturbing potential sites of mould growth. For example, removal of wallpaper can lead to a massive release of spores if there is mould growing on the underside of the paper. If you believe that you may have a hidden mould problem, consider hiring an experienced professional.

ENVIRONMENTAL ASSESSMENT AND SAMPLING FOR MOULD

The presence of mould, water damage, or musty odors should be addressed immediately. In all instances, any source(s) of water must be stopped and the extent of water damage determined. Water-damaged materials should be dried and repaired or replaced.

1. Visual Inspection:

A visual inspection is the most important initial step in identifying a possible contamination problem. The extent of any water damage and mould growth should be visually assessed. This assessment is important in determining remedial strategies. Ventilation systems should also be visually checked, particularly for damp filters but also for damp conditions elsewhere in the system and overall cleanliness. Ceiling tiles, gypsum wallboard (sheetrock), cardboard, paper, and other cellulosic surfaces should be given careful attention during a visual inspection. The visual assessment should include, crawl spaces, attics, inside cupboards and behind wallboards and furniture to determine if water damage is present. The use of equipment such as a boroscope, to view spaces in ductwork or behind walls, or a moisture meter or infrared camera, to detect moisture in building materials, may be helpful in identifying hidden sources of fungal growth and the extent of water damage.

2. Sampling:

Currently, there are no standards, or clear and widely accepted guidelines with which to compare results for health or environmental assessments. Hence sampling for mould should be conducted by professionals with specific experience in the design of mould sampling protocols, sampling

methods, and interpretation of results. Sample analysis should follow analytical methods recommended by professional organizations.

a) Bulk/Surface Sampling:

Bulk or surface sampling is not required to undertake a remediation. Remediation of visually identified fungal contamination should proceed without further evaluation. Bulk or surface samples may need to be collected to

- i. identify specific fungal contaminants as part of a medical evaluation if occupants are experiencing symptoms which may be related to fungal exposure or
- ii. identify the presence or absence of mould if a visual inspection is equivocal (e.g., discoloration, and staining).

An individual trained in appropriate sampling methodology should perform bulk or surface sampling. Bulk samples are usually collected from visibly mouldy surfaces by scraping or cutting materials with a clean tool into a clean plastic bag. Surface samples are usually collected by wiping a measured area with a sterile swab or by stripping the suspect surface with clear tape. Surface sampling is less destructive than bulk sampling. Other sampling methods may also be available. A laboratory specializing in mycology should be consulted for specific sampling and delivery instructions.

b) Air Monitoring / Sampling:

In most cases air sampling for fungi should not be part of the initial routine assessment. This is because decisions about appropriate remediation strategies can usually be made on the basis of a visual inspection. In addition, air-sampling methods for some fungi are prone to false negative results and therefore cannot be used to definitively rule out contamination. Air monitoring may be necessary if:

- i. an individual(s) has been diagnosed with a disease that is or may be associated with a fungal exposure (e.g., pulmonary hemorrhage / hemosiderosis, and aspergillosis).
- ii. if there is evidence from a visual inspection or bulk sampling that ventilation systems may be contaminated. The purpose of such air monitoring is to assess the extent of contamination throughout a building. It is preferable to conduct sampling while ventilation systems are operating.
- iii. if the presence of mould is suspected (e.g., musty odors) but cannot be identified by a visual inspection or bulk sampling (e.g., mould growth behind walls). The purpose of such air monitoring is to determine the location and/or extent of contamination.

If air monitoring is performed, for comparative purposes, outdoor air samples should be collected concurrently at an air intake, if possible, and at a location representative of outdoor air. Personnel conducting the sampling must be trained in proper air sampling methods for microbial contaminants. A laboratory specializing in mycology should be consulted for specific sampling and shipping instructions.

c) Analysis of Mould Samples:

Microscopic identification of the spores/colonies requires considerable expertise. These services are not routinely available from general commercial laboratories. Evaluation of bulk/surface and air sampling data should be performed by an experienced professional and documented quality control in the laboratories used for analysis of the bulk/surface and air samples is necessary. The presence of few or trace amounts of fungal spores in bulk/surface sampling should be considered background. Amounts greater than this or the presence of fungal fragments (e.g., hyphae, and conidiophores) may suggest fungal colonization, growth, and/or accumulation at or near the sampled location.

d) Interpretation / Evaluation of Mould Sample Results:

Again, because no health-based standards (e.g., OSHA or EPA standards) or exposure limits (e.g., NIOSH recommended exposure limits) for indoor biologic agents (airborne concentrations of mould or mould spores) exist; or clear and widely accepted guidelines with which to compare results for health or environmental assessments; results should be evaluated by individuals who are trained in the appropriate sampling methods and are aware of the limitations of the methods used. Results are assessed by means of comparison (i.e., indoors to outdoors) and by fungal type (e.g., genera, and species). In general, the levels and types of fungi found should be similar indoors (in non-problem buildings) as compared to the outdoor air. Differences in the levels or types of fungi found in air samples may indicate that moisture sources and resultant fungal growth may be present.

CLEANUP AND BIOCIDES:

Biocides are substances that can destroy living organisms. The use of a chemical or biocide that kills organisms such as mould (chlorine bleach, for example) is **not** recommended as a routine practice during mould cleanup. There may be instances, however, when professional judgment may indicate its use (for example, when immune-compromised individuals are present).

If you choose to use disinfectants or biocides, always ventilate the area and exhaust the air to the outdoors. Never mix chlorine bleach solution with other cleaning solutions or detergents that contain ammonia as toxic fumes may be produced.

In most cases, it is not possible or desirable to sterilize an area; a background level of mould spores will remain - these spores will not grow if the moisture problem has been resolved.

Please note: Dead mould may still cause allergic reactions in some people, so it is not enough to simply kill the mould, it must also be removed.

HAZARD COMMUNICATION:

When fungal growth requiring large-scale remediation is found, the building owner, management, and/or employer should notify occupants in the affected area(s) of its presence. Notification should include a description of the remedial measures to be taken and a timetable for completion. Group meetings held before and after remediation with full disclosure of plans and results can be an effective communication mechanism. Individuals with persistent health problems that appear to be related to bioaerosol exposure should see their physicians for a referral to practitioners who

are trained in occupational/environmental medicine or related specialties and are knowledgeable about these types of exposures. Individuals seeking medical attention should be provided with a copy of all inspection results and interpretation to give to their medical practitioners.

WORKER TRAINING

Proper training of workers is critical in successfully and safely remediating mould growth while protecting the health and safety of building occupants as well as the workers themselves. Trained building maintenance staff can address limited and occasional mould growth. For larger jobs, more extensively trained mould remediation workers may be needed. Training topics that should be addressed include, at minimum:

- a. Causes of moisture intrusion and mould growth
- b. Health concerns related to mould exposure
- c. The use of appropriate personal protective equipment
- d. Mould remediation work practices, procedures, and methods

STANDARD REMEDIATION PROCEDURES

The following remediation procedures are based on the **NYC Guidelines for the Assessment and Remediation of Fungi in Indoor Environments (2008)**. Three different sizes of remediation and the remediation of heating, ventilation, and air conditioning (HVAC) systems are described below. Currently, existing research does not relate the amount of mould growth to the frequency or severity of health effects. However, as the presence of mouldy materials increases, so does the potential for exposure and the need to limit the spread of mould-containing dusts and worker exposures. As such, the sizes of the area impacted by mould growth as well as practical considerations were used to help define remedial procedures; however, site-specific conditions must always be considered in choosing adequate remediation procedures.

Level I - Small Isolated Areas (less than 10 square feet) – *e.g.* ceiling tiles, small areas on walls

(a) Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mould exposure. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (*e.g.*, N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should also be worn.

(c) The work area should be unoccupied.

(d) If work may impact difficult-to-clean surfaces or items (*e.g.* carpeting, electronic equipment), the floor of the work area, egress pathways, and other identified materials/belongings should be removed or covered with plastic sheeting and sealed with tape before remediation.

(e) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent

solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(f) Mouldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in a sealed plastic bag(s). Plastic sheeting should be discarded after use. There are no special requirements for the disposal of mouldy materials.

(g) The work area and areas used by workers for egress should be HEPA-vacuumed (a vacuum equipped with a High-Efficiency Particulate Air filter) or cleaned with a damp cloth and/or mop and a soap or detergent solution.

(h) All areas should be left dry and visibly free from mould, dust, and debris. Check that other quality assurance indicators (see **Quality Insurance Indicators**) have also been met.

Level II - Medium-Sized Isolated Areas (10 – 100 square feet)

(a) Remediation can be conducted by trained building maintenance staff. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards associated with mould exposure. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g., N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should also be worn.

(c) The work area should be unoccupied.

(d) Cover the floor, egress pathways, and items left in the work area with plastic sheeting and seal with tape before remediation.

(e) Seal ventilation ducts/grills and other openings in the work area with plastic sheeting. The HVAC system servicing this area may need to be shut down to properly seal vents.

(f) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(g) Mouldy materials that can be cleaned should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. Plastic sheeting should be discarded after use. There are no special requirements for disposal of mouldy materials.

(h) The work area and areas used by workers for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution.

(i) All areas should be left dry and visibly free from mould, dust, and debris. Check that other quality assurance indicators (see **Quality Insurance Indicators**) have also been met.

Level III - Large Areas (greater than 100 square feet in a contiguous area) – e.g. on separate walls in a single room

Properly trained and equipped mould remediation workers should conduct the remediation. The presence of a trained building or environmental health professional (see **Environmental Assessment**) to provide oversight during remediation may be helpful to ensure quality work and compliance with the work plan. The following procedures are recommended:

- (a) Personnel trained in the handling of mould-damaged materials equipped with:
 - i. A minimum of half-face elastomeric respirators with P-100 filters used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134)
 - ii. Full body coveralls with head and foot coverings
 - iii. Gloves and eye protection
- (b) Containment of the affected area:
 - i. The HVAC system servicing this area should be shut down during remediation.
 - ii. Isolation of the work area using plastic sheeting sealed with duct tape. Furnishings should be removed from the area. Ventilation ducts/grills, any other openings, and remaining fixtures/furnishings should be covered with plastic sheeting sealed with duct tape.
 - iii. Consider using an exhaust fan equipped with a HEPA filter to generate negative pressurization.
 - iv. Consider using airlocks and a clean changing room.
 - v. Egress pathways should also be covered if a clean changing room is not used.
- (c) The work area should be unoccupied.

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) Mouldy materials, that can be cleaned, should be cleaned using a soap or detergent solution. Materials that cannot be cleaned should be removed from the building in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a soap or detergent solution or HEPA-vacuumed in the work area (or clean changing room) prior to their transport to unaffected areas of the building. There are no special requirements for the disposal of mouldy materials.

(f) Before leaving isolated areas, workers should remove disposable clothing to prevent the tracking of mould-containing dusts outside of the work area.

(g) The work area and egress pathways (and clean changing room if present) should be HEPA-vacuumed and cleaned with a damp cloth and/or mop with a soap or detergent solution and be visibly clean prior to the removal of isolation barriers. Plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mould, dust, and debris. Check that other quality assurance indicators (see **Quality Insurance Indicators**) have also been met.

REMEDICATION OF HVAC SYSTEMS

Mould growth in heating, ventilation, and air-conditioning (HVAC) systems can pose building-wide problems. Obtaining professional help should always be considered in addressing even small amounts of mould growth or moisture problems within an HVAC system. Recurring problems, regardless of size, may indicate a systemic problem and appropriate professional help should be sought.

Level I - Small Isolated Area of Mould Growth in the HVAC System (<10 square feet) –
e.g. box filter, small area on insulation

(a) Remediation can be conducted by trained building maintenance staff that are familiar with the design and function of the impacted HVAC system. Such persons should receive training on proper cleaning methods, personal protection, and potential health hazards. This training can be performed as part of a program to comply with the requirements of the OSHA Hazard Communication Standard (29 CFR 1910.1200).

(b) Respiratory protection (e.g. N-95 disposable respirator), in accordance with the OSHA respiratory protection standard (29 CFR 1910.134), is recommended. Gloves and eye protection should be worn.

(c) The HVAC system should be shut down prior to any remedial activities.

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) The use of plastic sheeting to isolate other sections of the system should be considered.

(f) Mouldy materials that can be cleaned should be cleaned using a soap or detergent solution. Growth-supporting materials that are mouldy, such as the insulation of interior-lined ducts, flexible ducts, and filters, should be removed and sealed in plastic bags. There are no special requirements for the disposal of mouldy materials.

(g) The work area and areas used for egress should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution. Any plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mould, dust and debris. Check that other quality assurance indicators (see **Quality Insurance Indicators**) have also been met.

Level II - Large Area of Mould Growth in the HVAC System (>10 square feet)

Properly trained and equipped mould remediation workers with specific training and experience in HVAC systems, should conduct the remediation. The presence of a trained building or environmental health professional (see **Environmental Assessment**) with experience and specific knowledge of HVAC systems, to provide oversight during remediation can be helpful to ensure quality work and compliance with the work plan. The following procedures are recommended:

(a) Personnel trained in the handling of mould-damaged materials equipped with:

- i. A minimum of half-face elastomeric respirators with P-100 filters used in accordance with the OSHA respiratory protection standard (29 CFR 1910.134)
- ii. Full body coveralls with head and foot coverings
- iii. Gloves and eye protection

(b) The HVAC system should be shut down prior to any remedial activities.

(c) Containment of the affected area:

- i. Isolation of work area from the other areas of the HVAC system using plastic sheeting sealed with duct tape
- ii. The use of an exhaust fan equipped with a HEPA filter to generate negative pressurization should be considered
- iii. Consider using airlocks and a clean changing room
- iv. Egress pathways should also be covered if a clean changing room is not used

(d) Efforts should be made to reduce dust generation. Dust suppression methods particularly during any cutting or resurfacing of materials are highly recommended. Methods to consider include: cleaning or gently misting surfaces with a dilute soap or detergent solution prior to removal; the use of High-Efficiency Particulate Air (HEPA) vacuum-shrouded tools; or using a vacuum equipped with a HEPA filter at the point of dust generation. Work practices that create excessive dust should be avoided.

(e) Mouldy materials that can be cleaned should be cleaned using a soap or detergent solution. Growth-supporting materials that are mouldy, such as the insulation of interior-lined ducts, flexible ducts, and filters, should be removed in sealed plastic bags. The outside of the bags should be cleaned with a damp cloth and a soap or detergent solution or HEPA-vacuumed prior to their removal from the isolated work area. There are no special requirements for the disposal of mouldy materials.

(f) Before leaving isolated areas, workers should remove disposable clothing to prevent the tracking of mould-containing dust outside of the work area.

(g) The work area and egress pathways (and clean changing room if present) should be HEPA-vacuumed and cleaned with a damp cloth and/or mop and a soap or detergent solution prior to the removal of isolation barriers. Plastic sheeting should be discarded after use.

(h) All areas should be left dry and visibly free from mould, dust, and debris. Check that other quality assurance indicators (see **Quality Insurance Indicators**) have also been met.

QUALITY ASSURANCE INDICATORS

Measures to ensure the quality and effectiveness of remediation should be undertaken regardless of the project size. Evaluations during, as well as after, remediation should be conducted to confirm the effectiveness of remedial work, particularly for large-scale remediation. At minimum, these quality assurance indicators should be followed and documented:

- b. The underlying moisture problem was identified and eliminated
- c. Isolation of the work area was appropriate and effective
- d. Mould removal and worksite cleanup was performed according to the site-specific plan
- e. Any additional moisture or mould damage discovered during remediation was properly addressed
- f. Upon completion of remediation, surfaces are free from visible dust and debris.
- g. If environmental sampling was performed, the results of such sampling were evaluated by a trained building or environmental health professional.

After completing remediation and correcting moisture problems, people should have been able to occupy or re-occupy the area without health complaints or physical symptoms. For larger projects (level II and above) final clearance should be provided by a health and safety specialist e.g. a Certified Industrial Hygienist (CIH) but ultimately, the declaration of free-from-mould contamination in a building is a judgment call; there are no easy answers.

CONCLUSION

In summary, whenever mould contamination is suspected in a building:

- a. The prompt remediation of contaminated material and infrastructure repair must be the primary response.
- b. The simplest and most expedient remediation that properly and safely removes fungal growth from buildings should be used.
- c. In all situations, the underlying cause of water accumulation must be rectified or the fungal growth will recur.
- d. Emphasis should be placed on preventing contamination through proper building maintenance and prompt repair of water damaged areas.
- e. Widespread contamination poses much larger problems that must be addressed on a case-by-case basis in consultation with a health and safety specialist.
- f. Effective communication with building occupants is an essential component of all remedial efforts.
- g. Individuals with persistent health problems should see their physicians for a referral to practitioners who are trained in occupational/environmental medicine or related specialties and are knowledgeable about these types of exposures.
- h. Persons carrying out mould remediation work must be adequately trained to address the level of contamination of the job; remediation work of larger scale, due to the potential impact, should be carried out in consultation with a health and safety specialist.

For more information on mould related issues including mould cleanup and moisture control/condensation/humidity issues, visit: www.epa.gov/iaq/moulds or contact the Cayman Islands Department of Environmental Health at: 949-6696.